

Remarks/Arguments:**I. Status of the Application**

Claims 6-11, 13 and 21-28 are pending in this application. In the April 5, 2007 office action, the Examiner:

- A. Objected to the amendments filed on 6/27/2005 and 1/17/2007 as introducing new matter;
- B. Rejected claims 6-9, 11, 22 and 25-28 under 35 U.S.C. § 112, first paragraph, for failing to comply with the written description requirement;
- C. Rejected claims 6 and 21-24 under 35 U.S.C. § 103(a), as allegedly being obvious over U.S. Patent No. 5,934,980 to Koos et al. (hereinafter “Koos”) in view of U.S. Patent No. 6,126,514 to Muroyama et al. (hereinafter “Muroyama”) in further view of U.S. Patent No. 5,985,045 to Kobayashi (hereinafter “Kobayashi”);
- D. Rejected claims 25-28 under 35 U.S.C. § 103(a) as allegedly being obvious over Koos in view of U.S. Patent No. 5,733,177 to Tsuchiya et al. (hereinafter “Tsuchiya”);
- E. Rejected claim 8 under 35 U.S.C. § 103(a) as allegedly being obvious over Koos in view of Tsuchiya in further view of U.S. Patent No. 5,780,358 to Zhou (hereinafter “Zhou”);
- F. Determined that claim 13 included allowable subject matter.

In this response, claims 22, 25 and 28 have been amended. The Applicant respectfully traverses the rejections of the claims and respectfully requests reconsideration in view of the foregoing amendments and accompanying remarks.

II. The Objections to the Specification

The Examiner objected to the specification because of amendments made in June, 2005. The specification as originally filed fully supports the elements recited in the amended claims.

Specifically, the Examiner has asserted that the specification fails to support the following claim language:

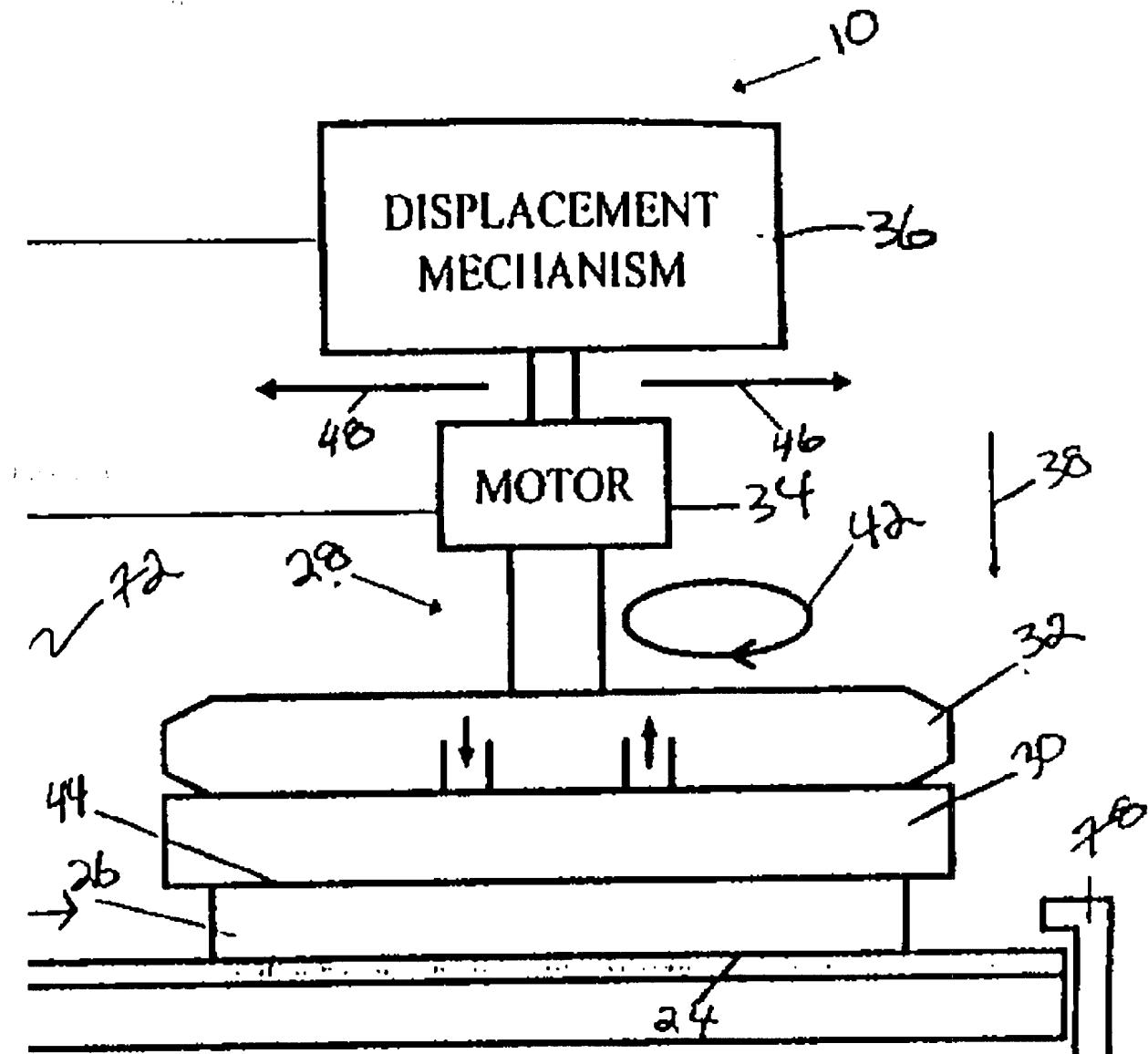
... reducing the pressure of said polishing pad on said semiconductor wafer after disposing said first volume of said aqueous slurry/nonaqueous solvent mixture onto said semiconductor wafer and before completing disposing said second volume of said aqueous slurry/nonaqueous solvent mixture onto said semiconductor wafer.

(Office Action at page 2).

Page 12, lines 17-20 of the Applicant's specification states:

Furthermore, if desired, controller 60 may cause wafer carrier 30 to decrease the force applied in the general direction of arrow 38 so as to facilitate the advancement of the nonaqueous solvent into contact with the front side 24 of the semiconductor wafer 26.

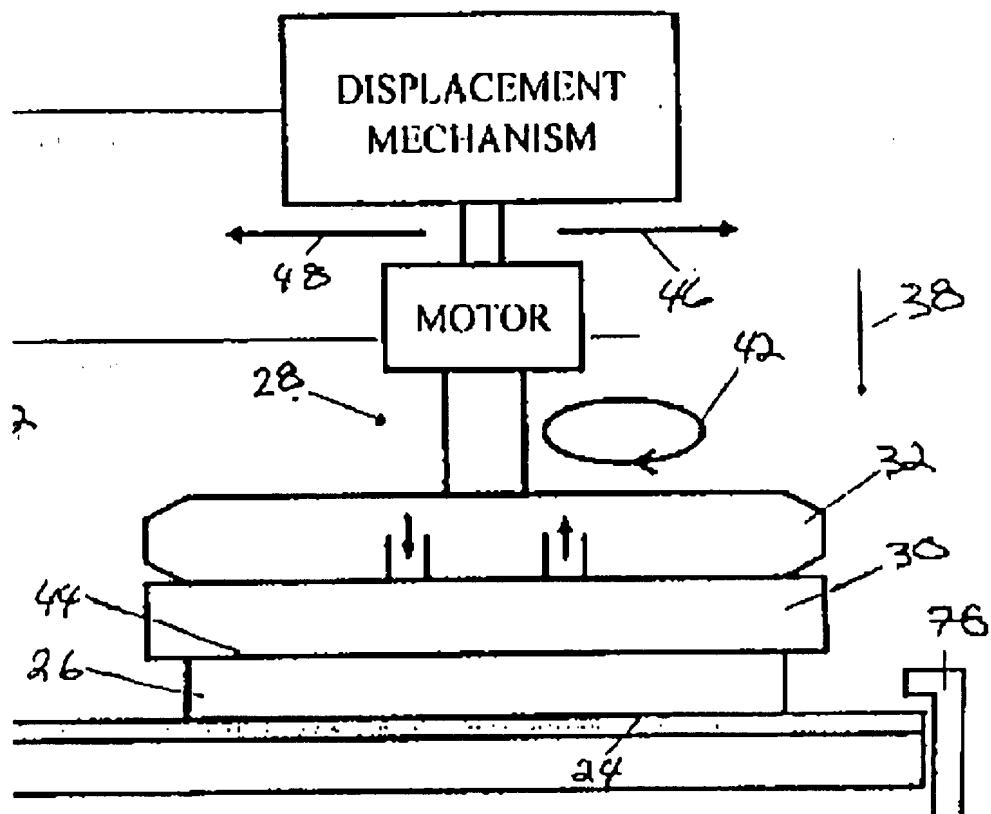
With reference to FIG. 1, a portion of which is set forth below, because the wafer carrier 30 is located upwardly of the semiconductor wafer 26, and because the general direction of the arrow 38 is downwardly, decreasing the force applied by the wafer carrier 30 in the direction of the arrow 38, as specifically described in the Applicant's specification as filed, necessarily results in a reduction of the force with which the front face 24 of the semiconductor wafer 26 is forced against the polishing pad 22 (located below the semiconductor wafer 26). Therefore, the specification clearly describes reducing the pressure between said polishing pad and said semiconductor wafer.



Additionally, the point in the process wherein the pressure is reduced is clearly described in that the effect of the reduction of pressure is that the deposition of the nonaqueous solvent on the semiconductor water is facilitated. Accordingly, the reduction of pressure is described as occurring prior to completion of the deposition of nonaqueous solvent on the semiconductor water.

Finally, with respect to the embodiment described at page 13 et seq., the Applicant's specification states "[t]he structure, operation and function of CMP

arrangement 82 is substantially similar to the previously discussed CMP arrangement 10, and thus only the differences between the CMP arrangement 82 and CMP arrangement 10 will be discussed herein." (Applicant's specification at page 13, lines 11-14). Thus, while the discussion on page 12 of the Applicant's specification is directed to the embodiment of FIG. 1, the discussion is also applicable to the embodiment of FIG. 2. As shown in FIG. 2, a portion of which is set forth below, the configuration of the wafer carrier 30, the arrow 38 and the front side 24 of the semiconductor wafer 26 in FIG. 2 is the same as the configuration of those elements in FIG. 1.



Therefore, because the elements set forth in the claims are fully supported by the Applicant's specification, the Applicant respectfully submits that the rejection of the specification was in error and should be withdrawn.

III. The Indefiniteness Rejection of Claims 6-9, 11, 22 and 25-28

The Examiner rejected claims 6-9, 11, 22 and 25-28 alleging that the “reducing” limitation discussed above was not supported by the specification. As discussed above, the “reducing” limitation is fully supported by the Applicant’s specification and the Applicant respectfully submits that the rejection of claims 6-9, 11, 22 and 25-28 under 35 U.S.C. 112, first paragraph, was in error and should be withdrawn.

IV. Claims 6 and 21-24 Are Not Obvious

The Examiner has rejected claims 6 and 21-24 as allegedly being obvious over Koos, Muroyama and Kobayashi. The claims are not obvious in view of the cited art.

Discussion Regarding the Patentability of Claim 21

1. Claim 21

Claim 21 recites:

A method of fabricating a semiconductor wafer, comprising:

- (a) mixing an aqueous slurry containing an abrasive material and a nonaqueous solvent in a mixing unit so as to create a first volume of an aqueous slurry/nonaqueous solvent mixture with a first weight % of said nonaqueous solvent prior to being disposed onto said semiconductor wafer;
- (b) disposing said first volume of the aqueous slurry/nonaqueous solvent mixture containing an abrasive material onto said semiconductor wafer;
- (c) polishing the semiconductor wafer with a polishing pad using said first volume;
- (d) mixing said aqueous slurry containing an abrasive material and said nonaqueous solvent so as to create a second volume of an aqueous slurry/nonaqueous solvent mixture having a greater weight % of said nonaqueous solvent than said first weight % prior to being disposed onto said semiconductor wafer;
- (e) disposing said second volume of said aqueous slurry/nonaqueous solvent mixture containing an abrasive material onto said semiconductor wafer; and
- (f) polishing said semiconductor wafer using said second volume.

Therefore, claim 21 requires that the *same* aqueous slurry containing an abrasive material is used to polish the semiconductor wafer a first time and a second time, the difference being that for the second polishing, the weight % of the aqueous slurry containing an abrasive material is decreased. Thus, the amounts of two components of a slurry are varied within a single polishing sequence.

2. The Combination Fails to Arrive at the Claimed Invention

The Examiner has alleged that the combination of Koos, Muroyama and Kobayashi describes each limitation of claim 21. Respectfully, the alleged combination fails to arrive at the invention of claim 21.

Specifically, the Examiner has acknowledged that Koos fails to describe each of the elements of claim 21. (Office Action at pages 6 and 7). One element that Koos does not describe is mixing a second volume of liquid using the same two ingredients (aqueous slurry containing an abrasive material and a nonaqueous solvent) that were used in mixing the first volume of liquid but at a weight % different than the first volume of liquid. Neither of the other sources identified by the Examiner describes this type of process.

As noted by the Examiner, Muroyama teaches the use of a ketone based solvent. (Office Action at page 7). Muroyama teaches that a ketone based solvent is used “if the solubility of the fatty acid and/or fatty acid ester in the dispersion medium is insufficient.” (Muroyama at column 4, lines 64-67). Thus, Muroyama teaches that if needed, “[t]he added amount of the ketone based solvent may be in a range of 0.1% to 10%, preferably, in a range of 1% to 3%.” (Muroyama at column 5, lines 5-7).

Therefore, according to Muroyama, the amount of ketone solvent in any particular mixture, if any, is a function of the need to increase the solubility of the dispersion medium. Muroyama does not describe varying the concentration of the polishing fluid during a polishing sequence.

The Examiner also notes that Kobayashi teaches a polishing fluid which is provided in a concentrated form and mixed with an effluent. (Office Action at page 7). As shown in FIG. 1, the device of Kobayashi uses a static in-line mixer 123. The mixer 123 thoroughly mixes the fluids introduced through feed lines 113 and 114. (Kobayashi at column 3, lines 50-53). To ensure thorough mixing, Kobayashi teaches that “equal volumes of fluid may flow through each of the feed lines to more efficiently mix the components within the in-line mixer 123.” (Kobayashi at column 5, lines 8-10).

Kobayashi appears to acknowledge that different users may desire a slurry that is more than or less than 50% diluted. To provide this capability, Kobayashi teaches that for a particular system, additional stages may be used to further mix the effluent of the first static mixer. Thus, Kobayashi teaches that “dilution rates do not need to be a factor of two. Virtually any dilution ratio may be achieved.” (Kobayashi at column 5, lines 33-35). Therefore, while describing a system that can be designed to provide “virtually” any particular ratio, Kobayashi fails to describe varying the concentration of the polishing fluid during a polishing sequence.

Accordingly, while Kobayashi describes how to generate specific slurries having different concentrations of ingredients, and while Muroyama describes the use of different amounts of a ketone solvent to provide the requisite solubility for different dispersion mediums, neither Kobayashi nor Muroyama teach, suggest or describe varying

the relative amounts of two components in a slurry during a single polishing sequence. Accordingly, because the Examiner has not identified any art wherein the *same* aqueous slurry containing an abrasive material is used to polish the semiconductor wafer a first time and a second time, the difference being that for the second polishing, the weight % of the aqueous slurry containing an abrasive material is decreased, the proposed combination does not arrive at the invention recited in claim 21. Thus, under MPEP § 2143.03, claim 21 is patentable over the prior art.

3. The Examiner's Line of Reasoning is Not Convincing

The Examiner appears to provide a line of reasoning as the "motivation" to combine the references so as to arrive at the invention recited in claim 21. The line of reasoning is not convincing.

Specifically, the Examiner argues that since "diluting an aqueous slurry with a nonaqueous solvent is known, then using the said combination in the same manner as claimed by Applicants would result the same." The prior art does not, however, teach *varying* the concentration during a single polishing process. Thus, while a number of static mixer stages as taught by Kobayashi may be used to provide a single concentration, there is no teaching as to how one would change the number or combination of stages "on the fly" during a single polishing sequence to vary the concentration during the single polishing sequence.

Therefore, because the prior art does not describe varying the concentration of the components in a slurry mix during a sequence of polishing, using the combination suggested by the Examiner would not arrive at the method claimed by the Applicant.

Therefore, the Examiner has failed to provide a convincing line of reasoning. Because the Examiner has failed to provide a convincing line of reasoning as required by MPEP § 2144, citing to *Ex parte Clapp*, 227 USPQ 972 (Bd. Pat. App. & Inter. 1985), the Examiner has failed to provide a *prima facie* case of obviousness. Accordingly, the Examiner is respectfully requested to withdraw the rejection of claim 21.

4. Conclusion

For any or all of the foregoing reasons, it is respectfully submitted that the rejection of claim 21 as obvious over Koos in view of Muoyama and Kobayashi has been successfully traversed, and the Applicant respectfully submits that the rejection of claim 21 should be withdrawn.

Discussion Regarding the Patentability of Claims 6 and 22-24

All of claims 6 and 22-24 depend from claim 21, either directly or by way of one or more intermediate claims, and include the limitations discussed above with respect to claim 21. Therefore, for at least the reasons set forth above with respect to claim 21, claims 6 and 22-24 are patentable over the prior art.

V. Claims 25-28 Are Not Obvious

The Examiner has rejected claims 25-28 as allegedly being obvious over Koos, in view of Tsuchiya. The claims are not obvious in view of the cited art.

*Discussion Regarding the Patentability of Claim 25*1. Claim 25

Claim 25 recites:

A method of fabricating a semiconductor wafer, comprising:

- (a) disposing a volume of an aqueous slurry containing an abrasive material onto a semiconductor wafer and polishing the semiconductor wafer with a polishing pad, said polishing pad in contact with said semiconductor wafer when said volume of aqueous slurry is disposed onto said semiconductor wafer;
- (b) disposing a volume of nonaqueous liquid including a nonaqueous solvent onto said semiconductor wafer to rinse the semiconductor wafer; and
- (c) facilitating the advancement of the nonaqueous liquid into contact with the semiconductor wafer by reducing the pressure between said polishing pad and said semiconductor wafer prior to completing disposing the volume of nonaqueous liquid including the nonaqueous solvent onto said semiconductor wafer.

Therefore, claim 25 includes a step of bringing nonaqueous liquid into contact with a semiconductor wafer by reducing the pressure between a polishing pad and the semiconductor wafer.

2. The Combination Fails to Arrive at the Claimed Invention

The Examiner has admitted that Koos fails to teach reducing pressure but relied upon Tsuchiya for describing that step. (Office Action at pages 8-9). Claim 25 has been amended to clarify that the reduction of pressure is performed as part of a step for bringing a nonaqueous liquid into contact with the semiconductor wafer. Tsuchiya does not disclose a process with this limitation.

Specifically, the Examiner identified claim 8 of Tsuchiya as teaching the reduction of pressure between the polishing pad and a wafer. (Office Action at page 9). Claim 8 of Tsuchiya recites, in pertinent part, “in said final wafer flattening stage the relative speed between the polishing pad and the wafer is quickly increased to promote chemical polishing and the applied pressure between the polishing pad and the wafer is

simultaneously quickly decreased to reduce mechanical abrasion effects.” Thus, Tsuchiya teaches *reducing mechanical abrasion by reducing pressure*. In contrast, claim 25 has been amended to clarify that the claimed process includes the step of “*facilitating the advancement of the nonaqueous liquid into contact with the semiconductor wafer by reducing the pressure*.” Reducing mechanical abrasion effects is not the same as facilitating advancement of a liquid.

Therefore, because the prior art does not describe facilitating advancement of a liquid by reducing pressure, using the combination suggested by the Examiner would not arrive at the method claimed by the Applicant. Accordingly, a *prima facie* case of obviousness has not been made with respect to claim 25 and the Examiner is respectfully requested to withdraw the rejection of claim 25.

Discussion Regarding the Patentability of Claims 7-11 and 28

Claims 7-11 and 28 depend from claim 25 and include the limitations discussed above with respect to claim 25. Therefore, for at least the reasons set forth above with respect to claim 25, claims 7-11 and 28 are patentable over the prior art.

Discussion Regarding the Patentability of Claims 26 and 27

Claims 26 and 27 depend from claim 13, either directly or by way of one or more intermediate claims, and include the limitations of claim 13. Therefore, because the Examiner has determined that claim 13 is patentable over the prior art, claims 26-27 are patentable over the prior art.

VI. Conclusion

For the foregoing reasons, it is respectfully submitted that applicants have made a patentable contribution to the art. Applicant respectfully requests entry of the amendment and favorable consideration of the application.

Respectfully Submitted,
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